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Komazawa et al.

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(54) **LIGHT EMITTING DEVICE, DISPLAY DEVICE, PHOTOELECTRIC CONVERSION DEVICE, ELECTRONIC APPARATUS, ILLUMINATION DEVICE, AND MOVING BODY**

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G09G 3/3233 (2016.01)

(52) **U.S. Cl.**
CPC ... ***G09G 3/3233*** (2013.01); *G09G 2320/0626* (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

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(74) *Attorney, Agent, or Firm* — Venable LLP

(57) **ABSTRACT**

A light emitting device in which a pixel is arranged is provided. The pixel includes a light emitting element, a first transistor configured to supply, to the light emitting element, a current corresponding to a luminance signal, and a second transistor configured to supply the luminance signal to a gate electrode of the first transistor. Diffusion regions respectively functioning as a source region and a drain region of the second transistor are of a first conductivity type, and a gate electrode of the second transistor is of a second conductivity type opposite to the first conductivity type.

31 Claims, 17 Drawing Sheets

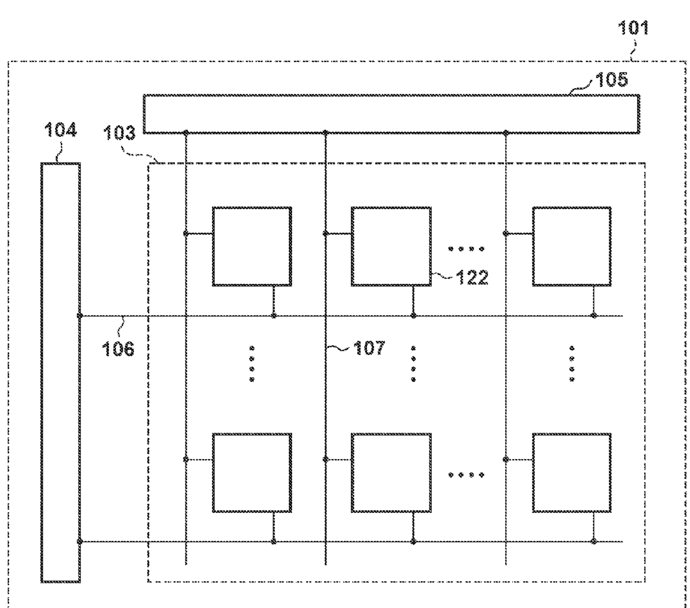

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FIG. 1

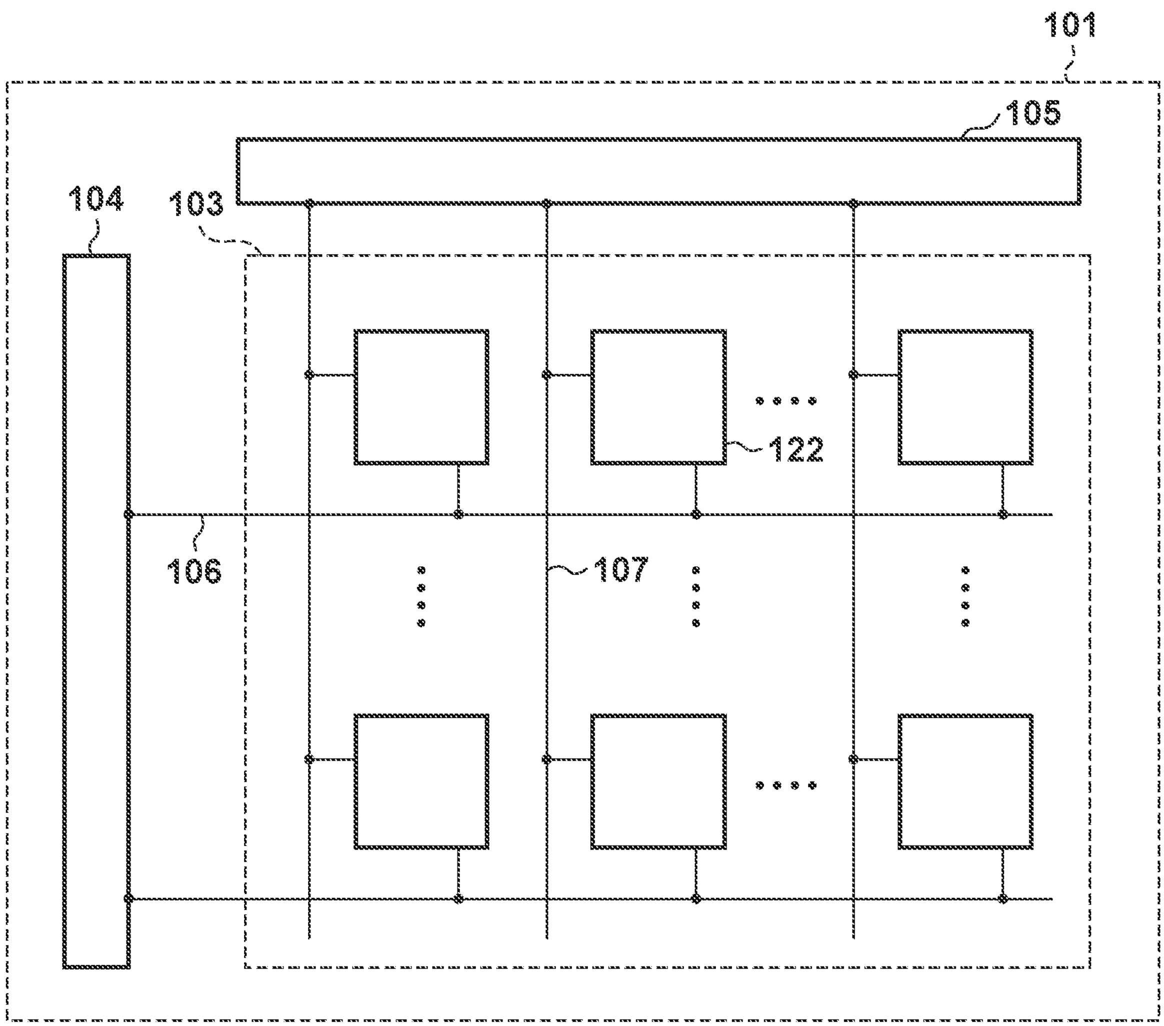


FIG. 2

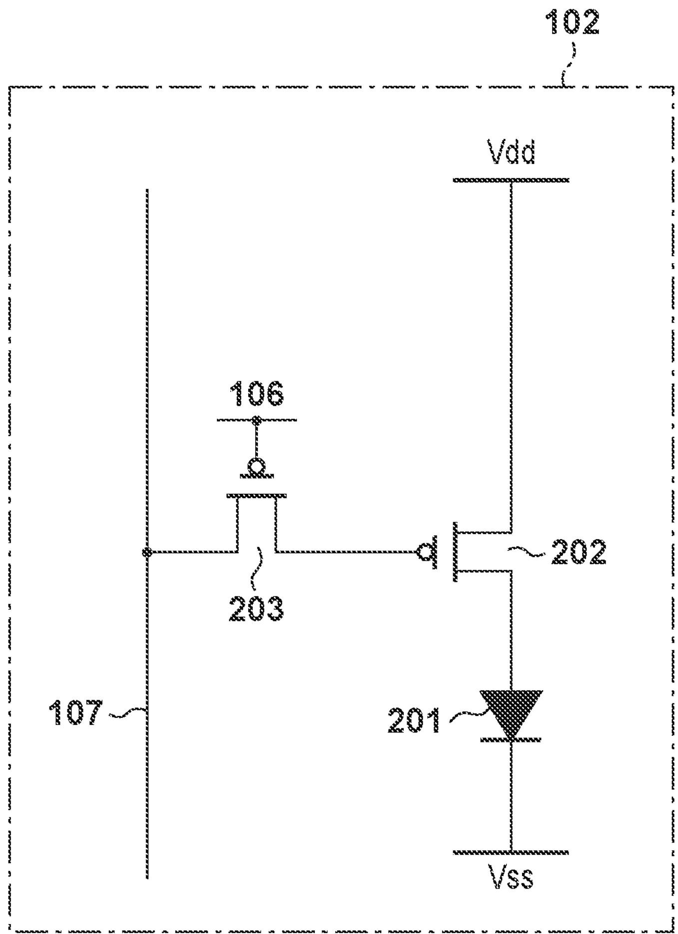


FIG. 3

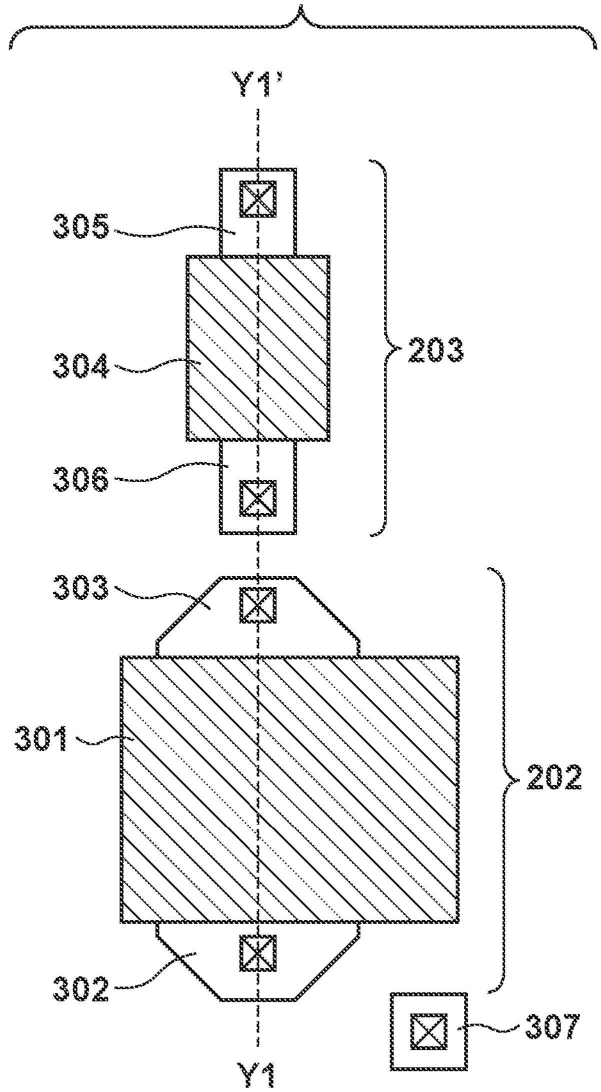


FIG. 4

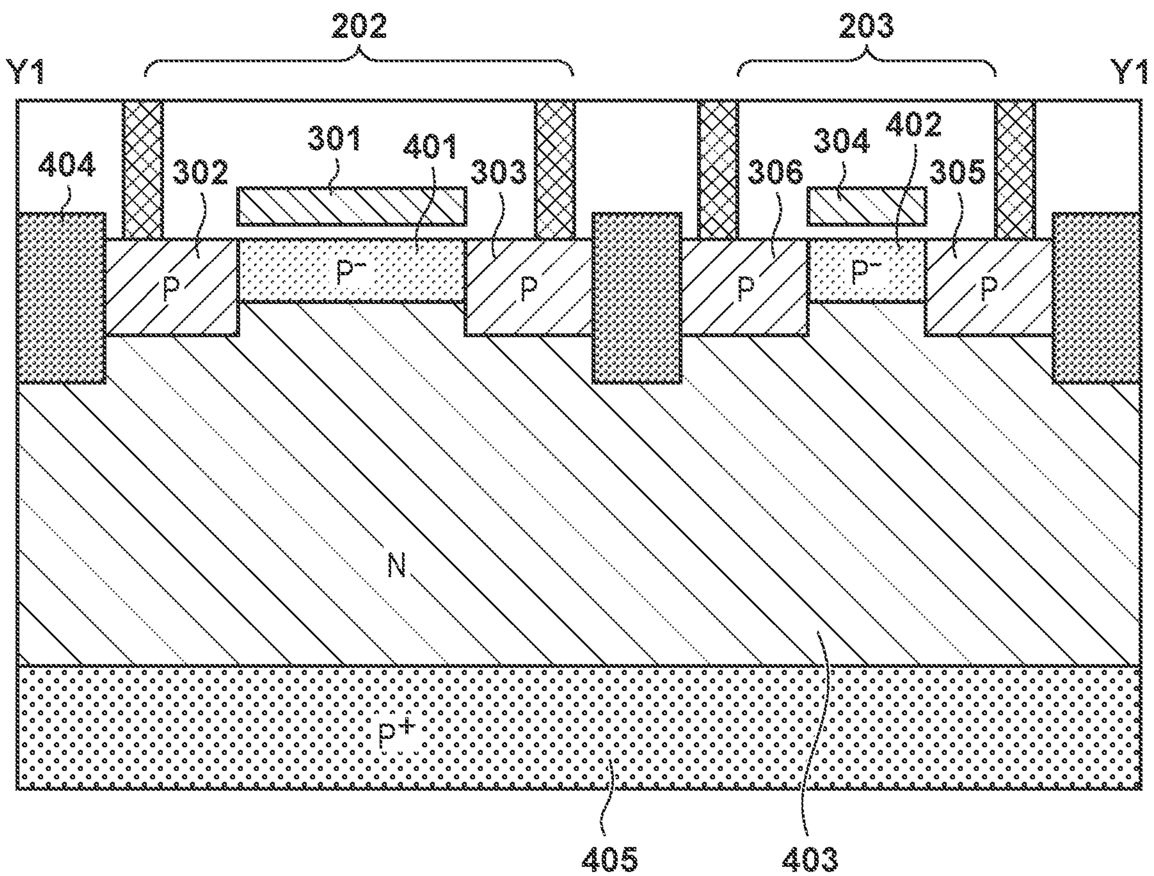

202
203
Y1
Y1'
404
302
301
401
303
306
304
402
305
P
P⁻
P
P
P⁻
P
N
P+
405
403

FIG. 5

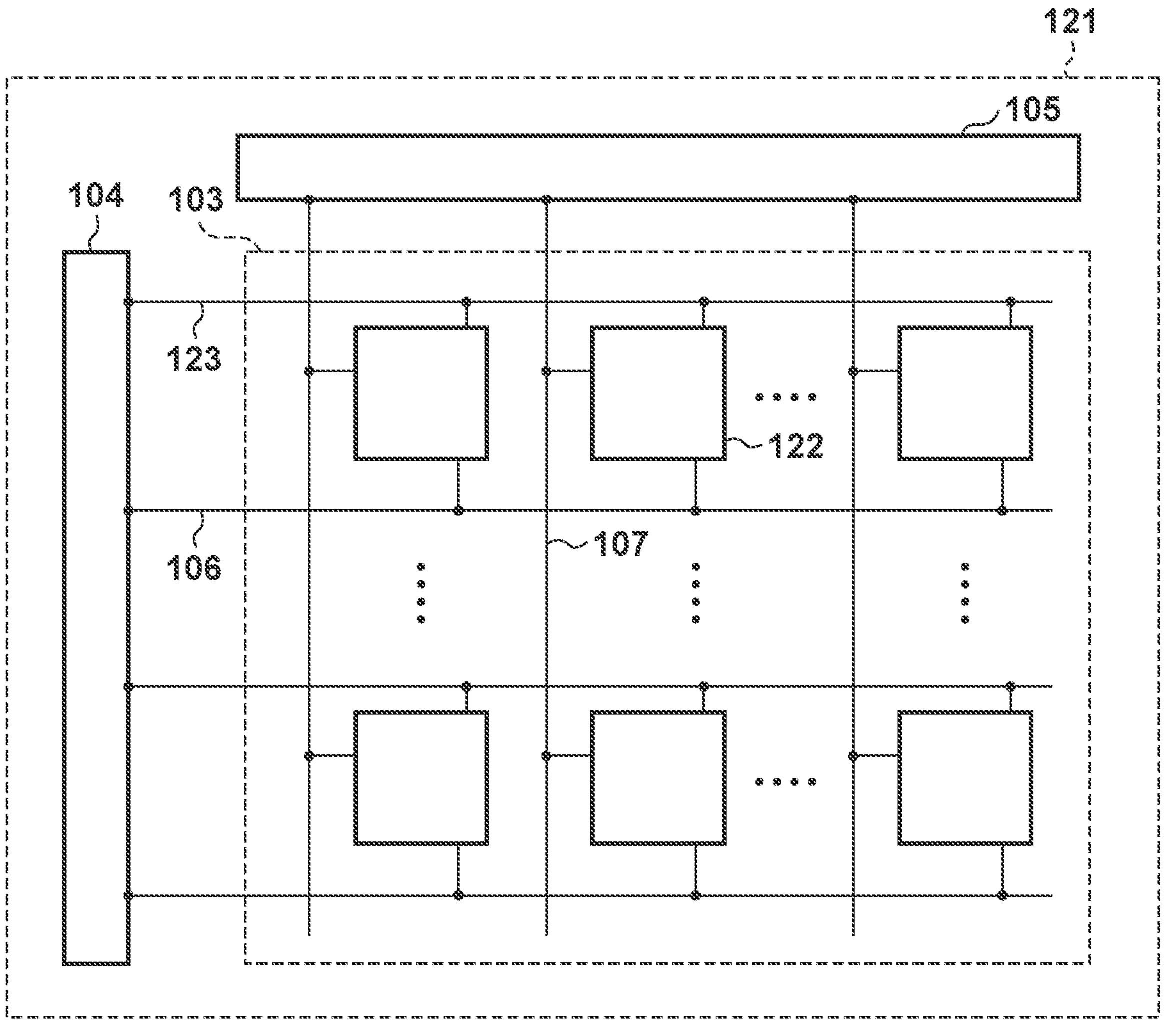


FIG. 6

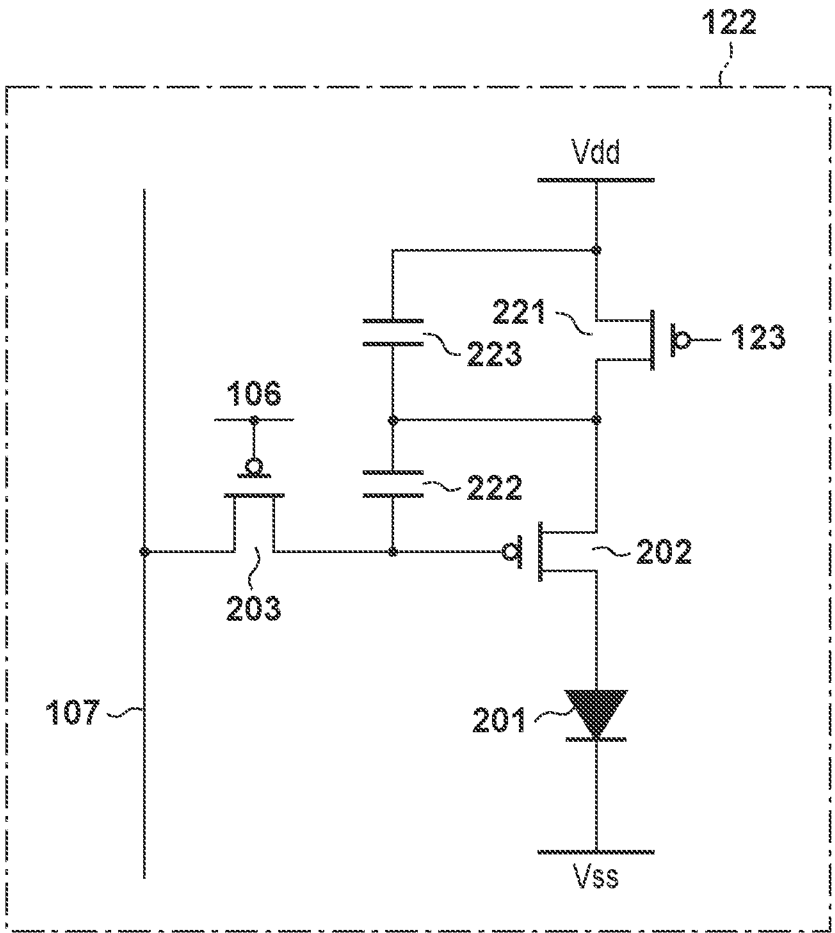


FIG. 7

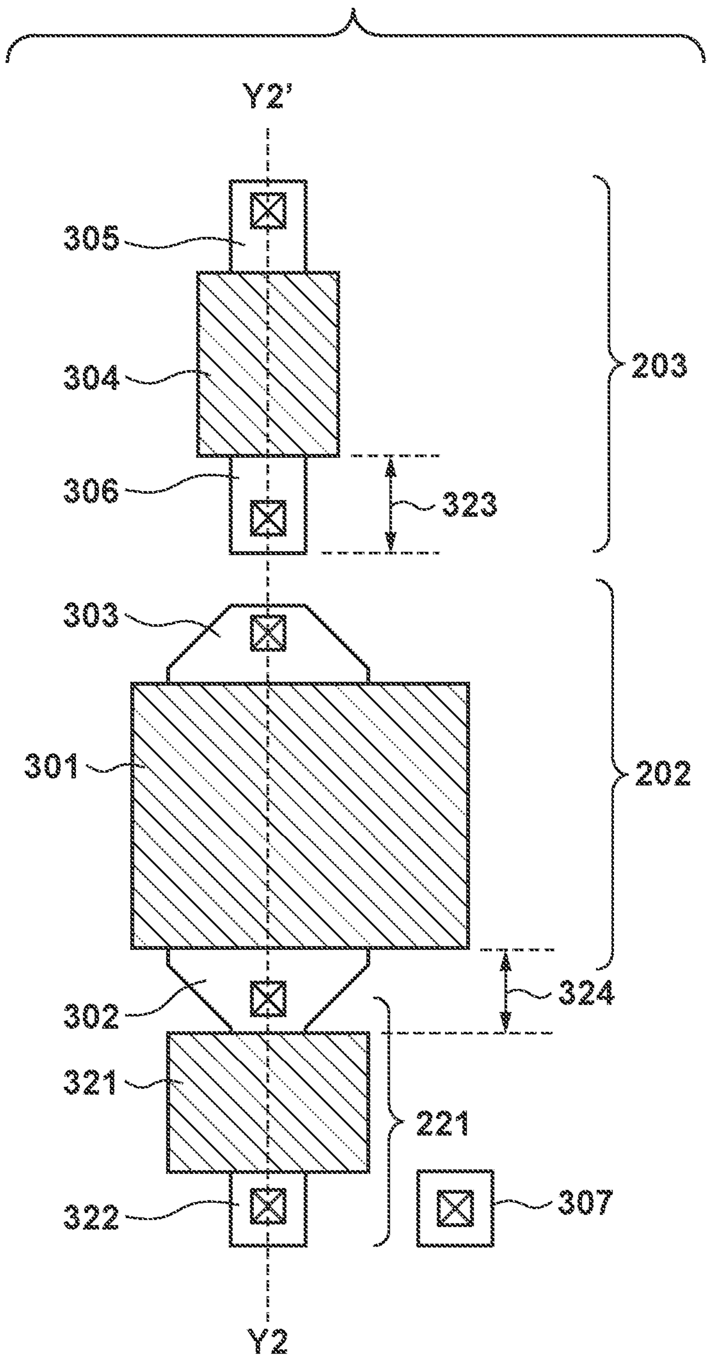


FIG. 8

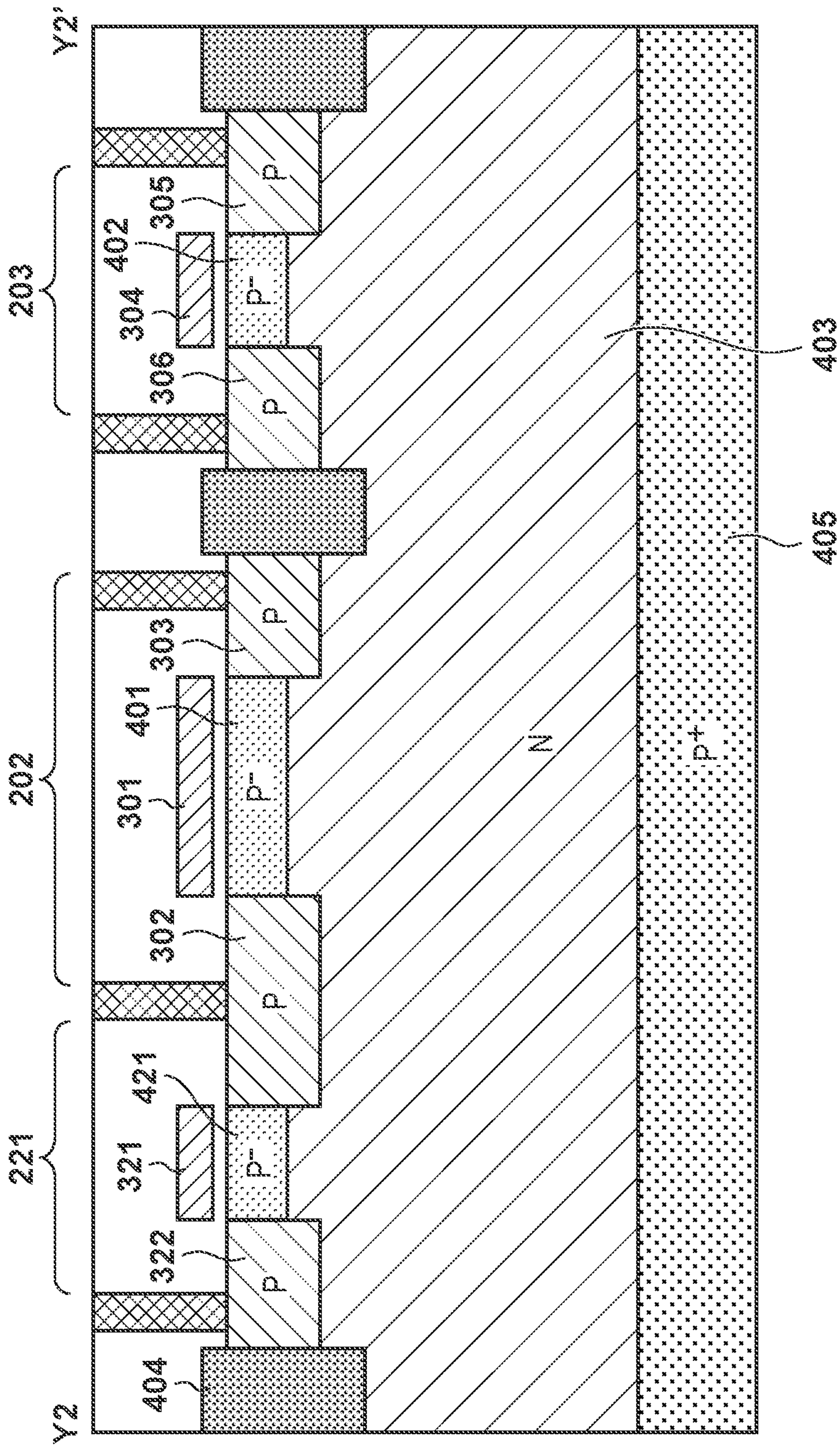

Y2'
Y2
203
202
221
305
402
304
306
303
401
301
302
421
321
322
404
403
405
P
P⁻
N
P⁺

FIG. 9

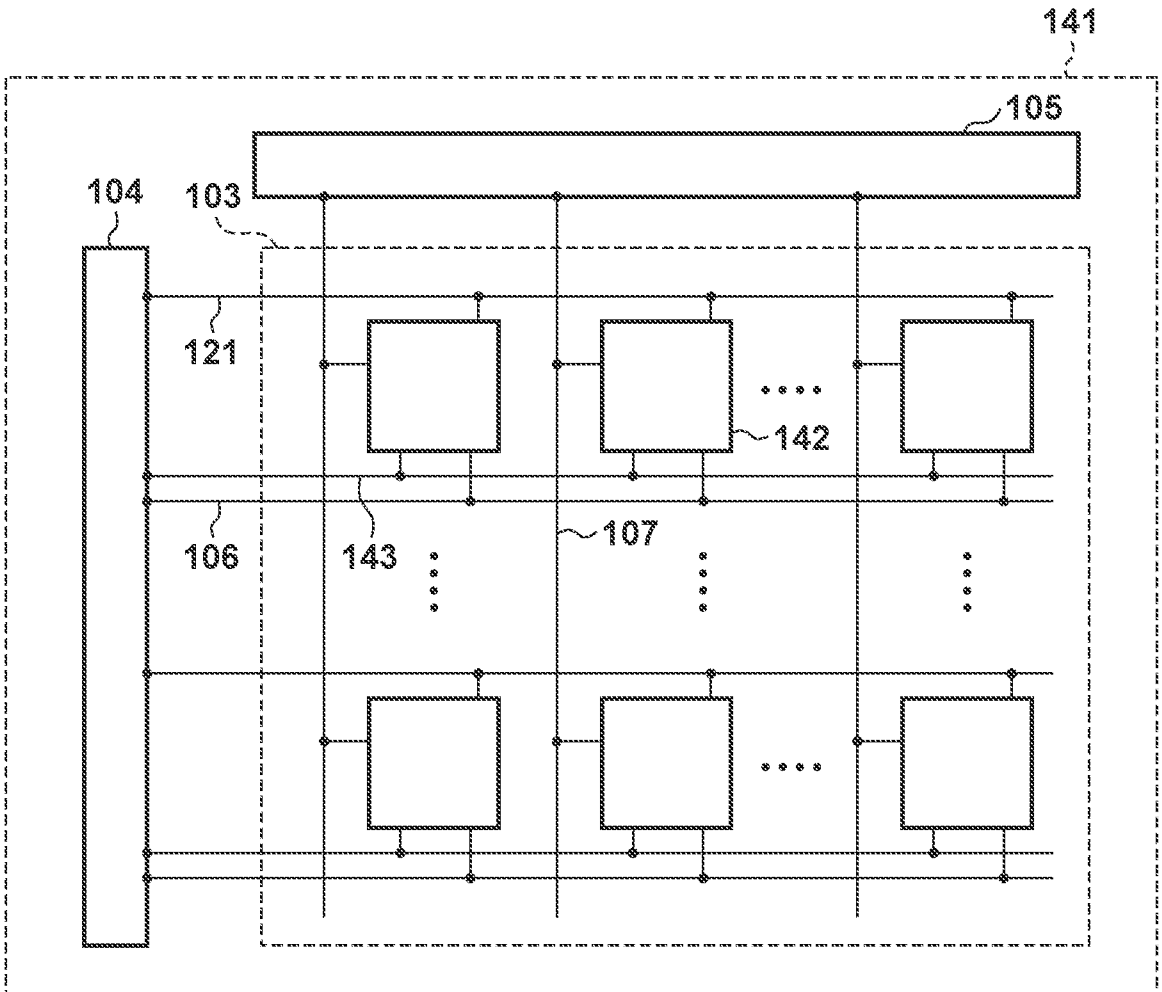


FIG. 10

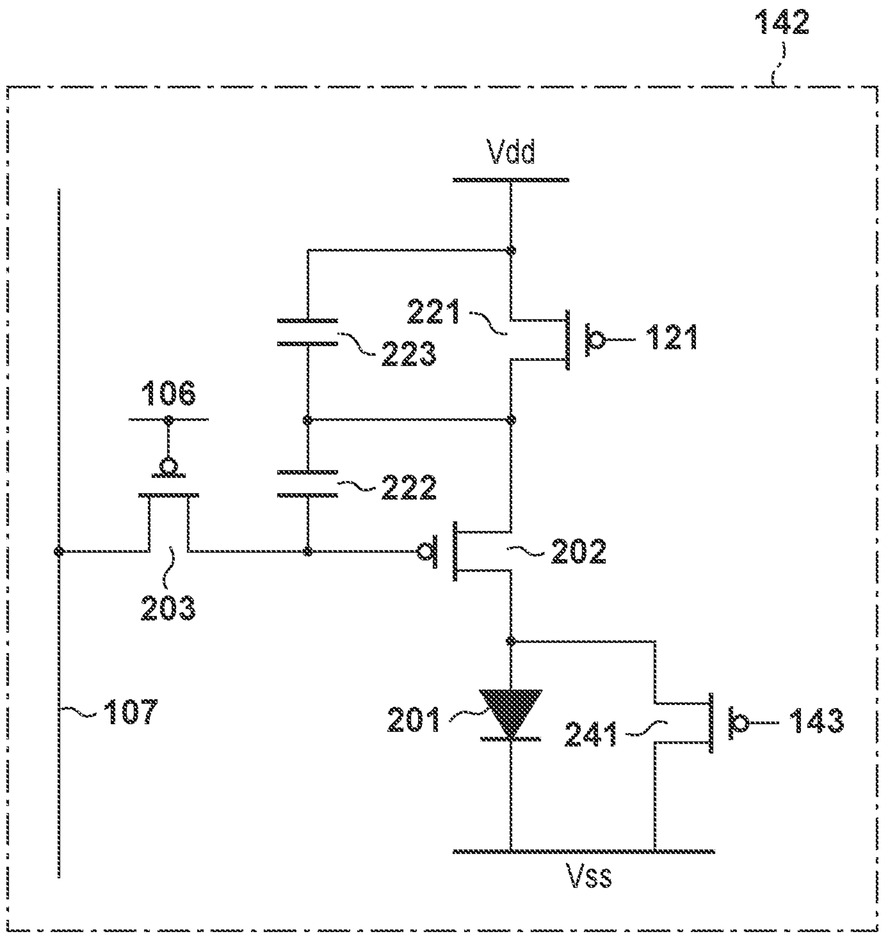


FIG. 11

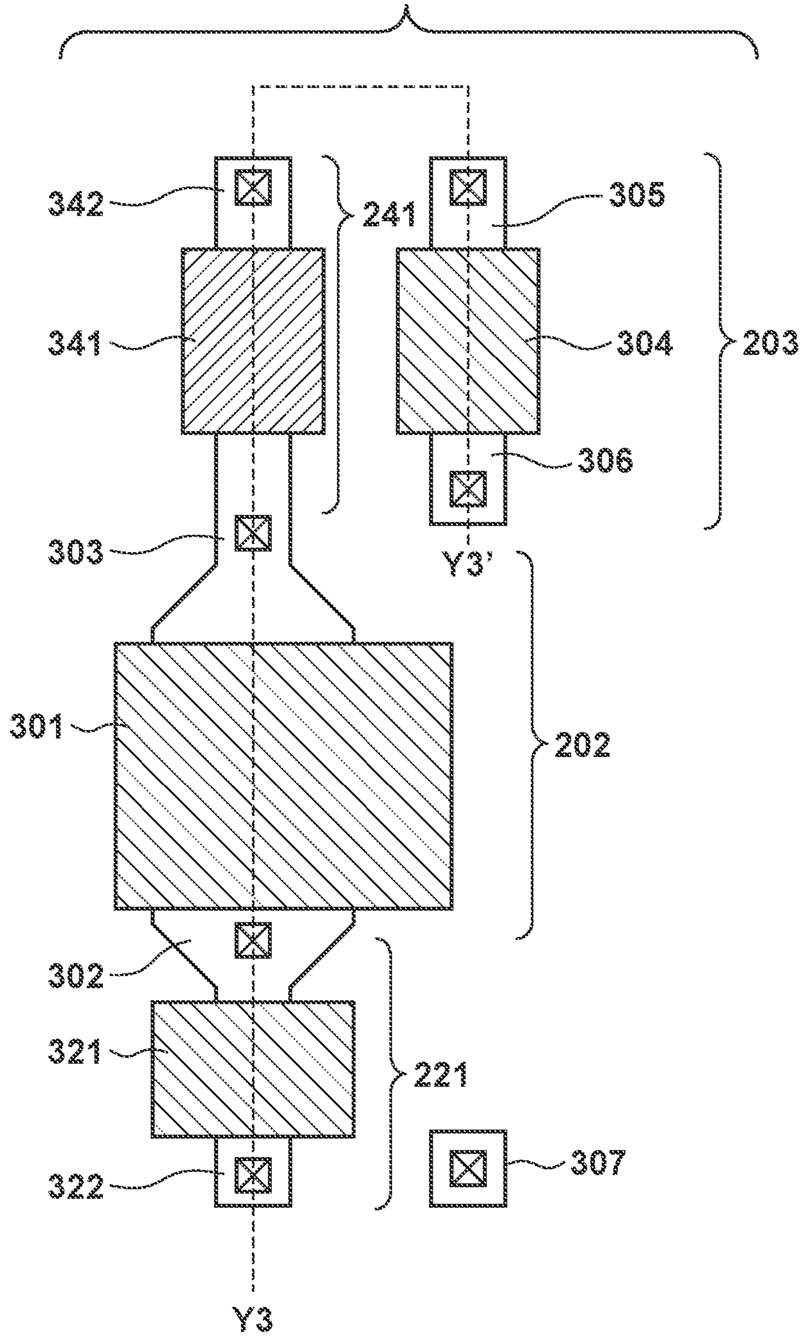
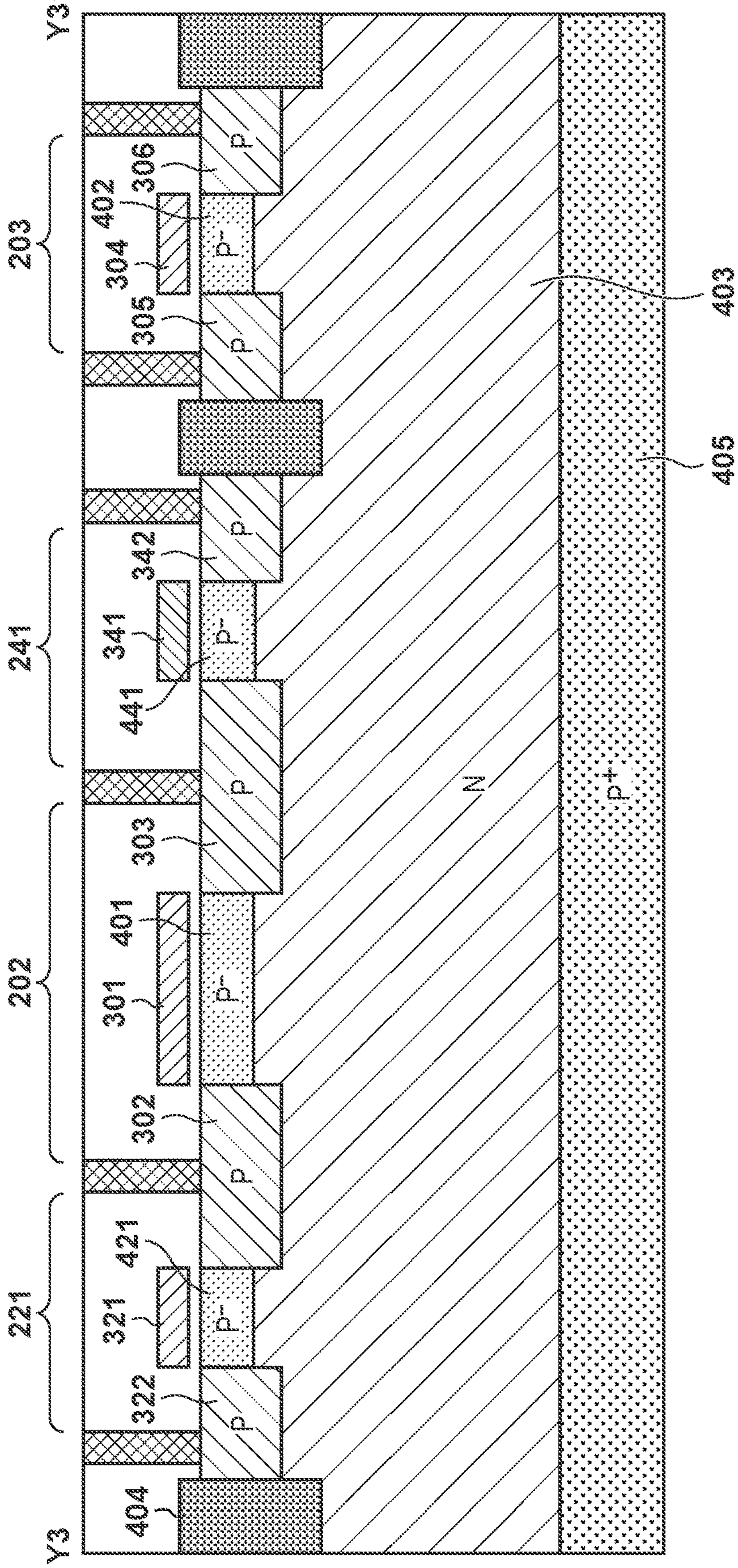
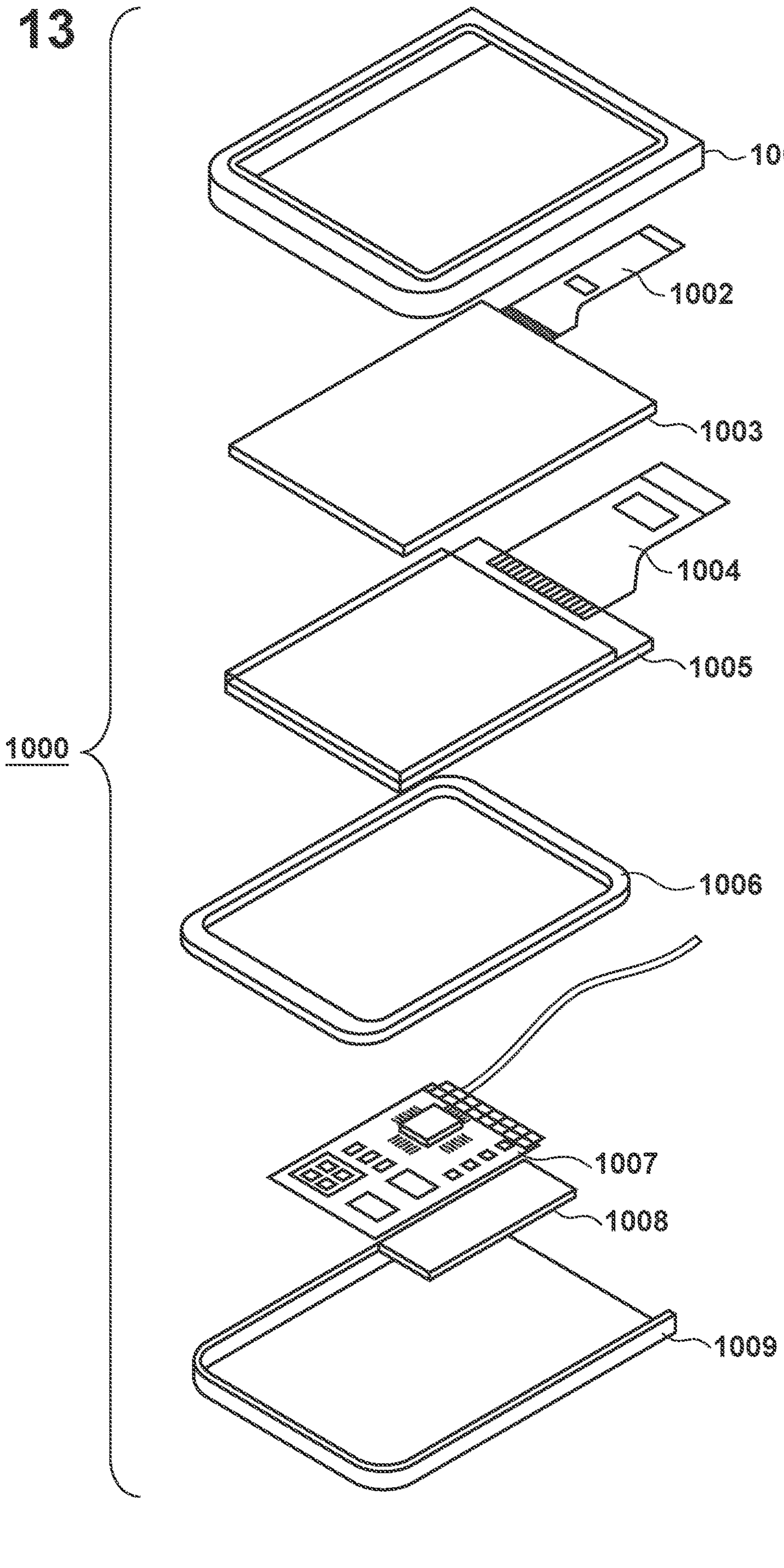


FIG. 12

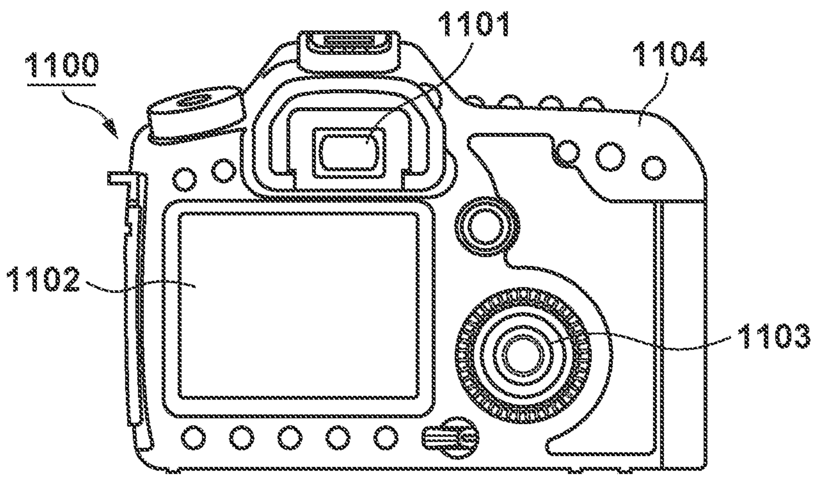


Y3
Y3'
404
322
321
421
221
302
301
401
202
303
441
341
342
241
305
304
402
306
203
403
405
P
P⁻
N
P⁺

FIG. 13



F I G. 14



F I G. 15

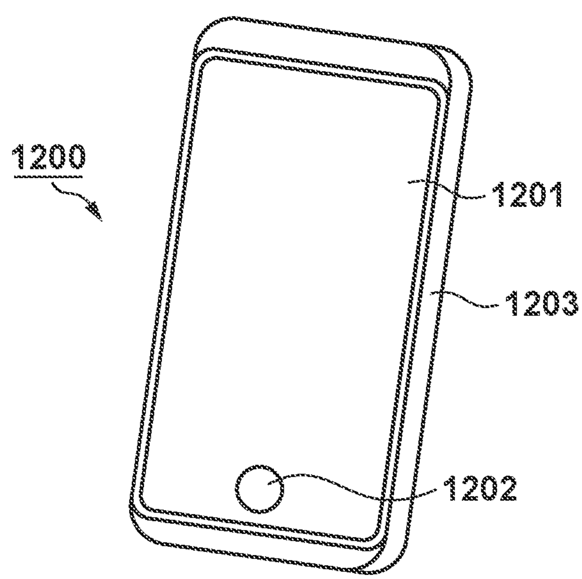


FIG. 16A

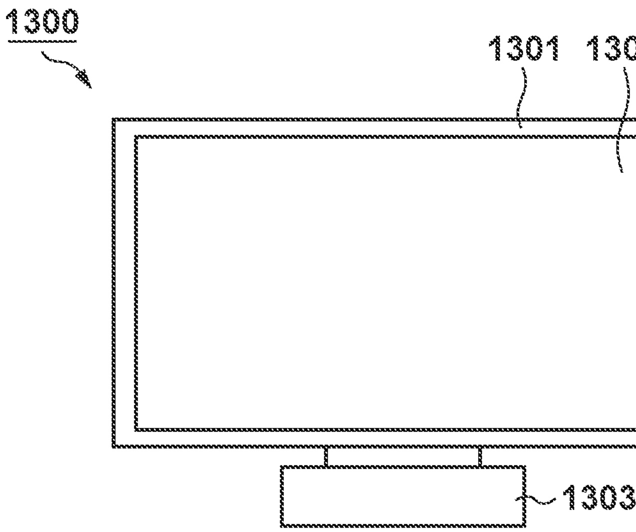


FIG. 16B

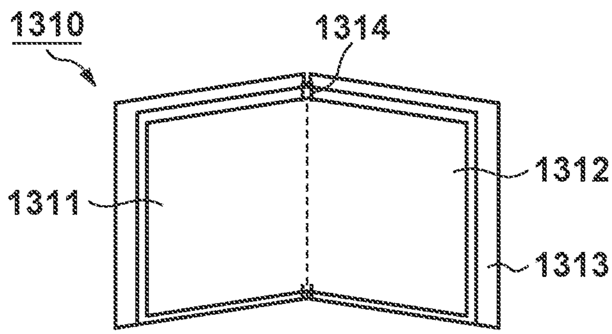


FIG. 17

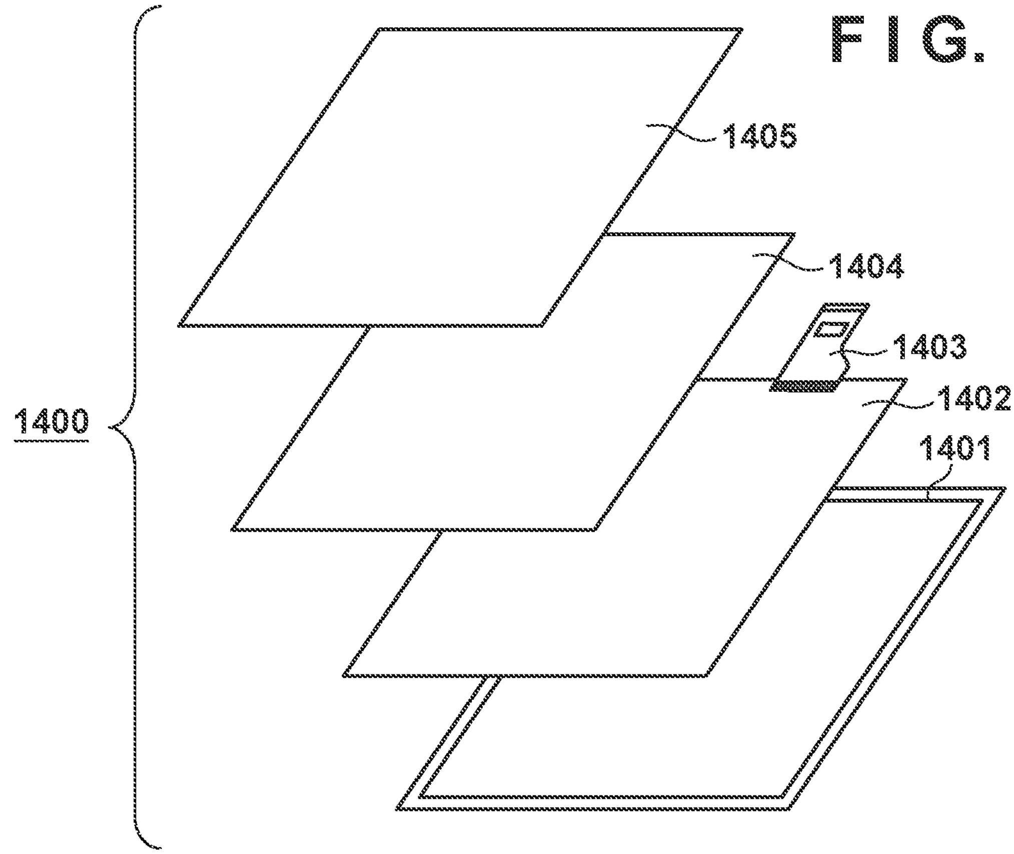


FIG. 18

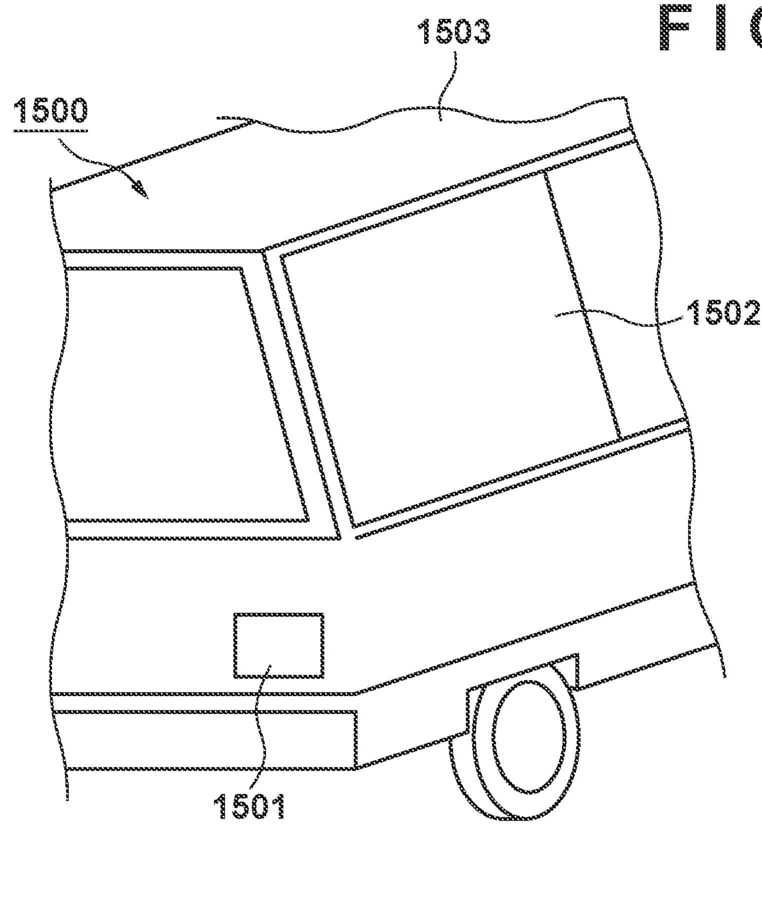


FIG. 19A

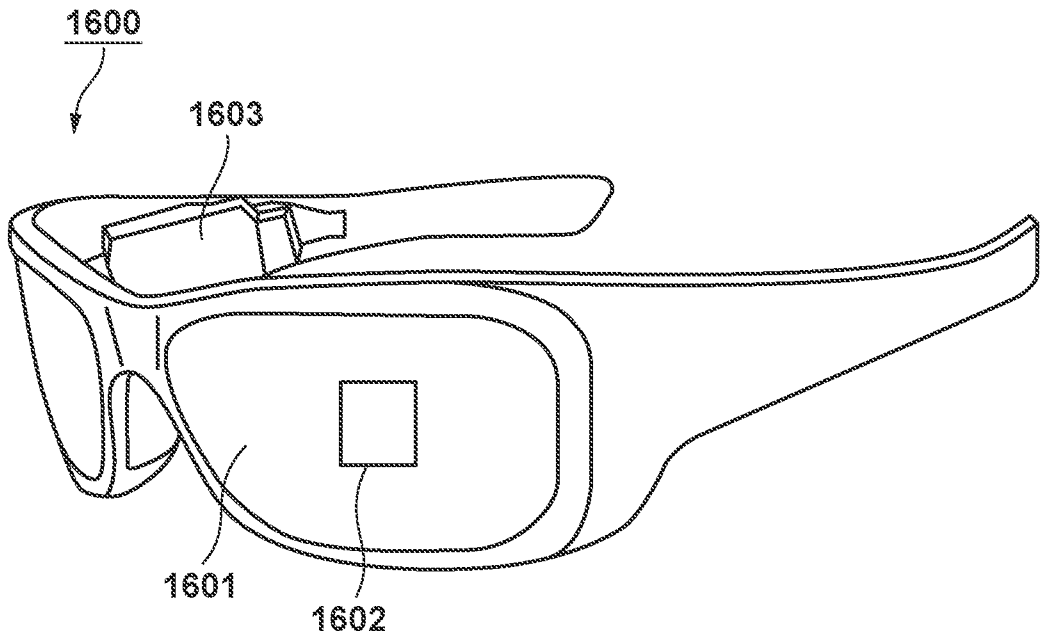
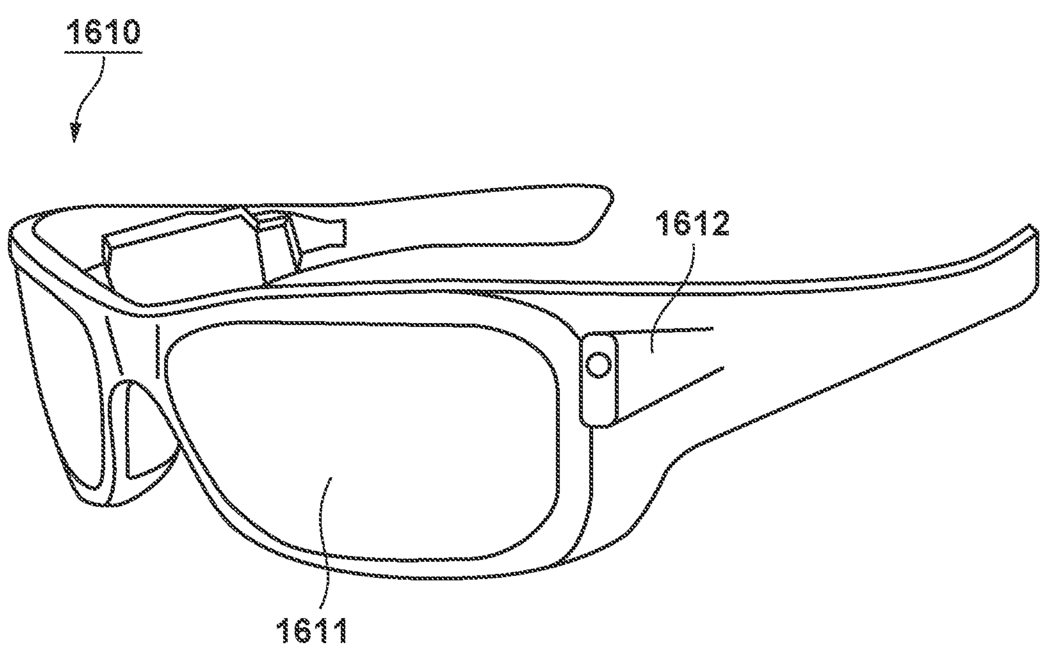


FIG. 19B



LIGHT EMITTING DEVICE, DISPLAY DEVICE, PHOTOELECTRIC CONVERSION DEVICE, ELECTRONIC APPARATUS, ILLUMINATION DEVICE, AND MOVING BODY

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a light emitting device, a display device, a photoelectric conversion device, an electronic apparatus, an illumination device, and a moving body.

Description of the Related Art

There is known a light emitting device using a self-light emitting element such as an organic electroluminescence (EL) element. Japanese Patent Laid-Open No. 2020-064265 describes a display device provided with pixels each including a driving transistor configured to supply, to a light emitting element, a current corresponding to a luminance signal, and a write transistor configured to supply the luminance signal to the driving transistor.

SUMMARY OF THE INVENTION

If a luminance signal supplied to a driving transistor changes due to an off-leakage current of a write transistor, the light emission luminance of a light emitting element also changes, resulting in deterioration of the image quality of a light emitting device. To improve display quality, it is necessary to suppress the off-leakage current of the write transistor.

Some embodiments of the present invention provide a technique advantageous in improving display quality.

According to some embodiments, a light emitting device in which a pixel comprising a light emitting element, a first transistor configured to supply, to the light emitting element, a current corresponding to a luminance signal, and a second transistor configured to supply the luminance signal to a gate electrode of the first transistor is arranged, wherein diffusion regions respectively functioning as a source region and a drain region of the second transistor are of a first conductivity type, and a gate electrode of the second transistor is of a second conductivity type opposite to the first conductivity type, is provided.

Further features of the present invention will become apparent from the following description of exemplary embodiments (with reference to the attached drawings).

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a view showing an example of the arrangement of a light emitting device according to an embodiment;

FIG. **2** is a circuit diagram showing an example of the arrangement of a pixel of the light emitting device shown in FIG. **1**;

FIG. **3** is a plan view showing the example of the arrangement of the pixel of the light emitting device shown in FIG. **1**;

FIG. **4** is a sectional view showing the example of the arrangement of the pixel of the light emitting device shown in FIG. **1**;

FIG. **5** is a view showing an example of the arrangement of a light emitting device according to the embodiment;

FIG. **6** is a circuit diagram showing an example of the arrangement of a pixel of the light emitting device shown in FIG. **5**;

FIG. **7** is a plan view showing the example of the arrangement of the pixel of the light emitting device shown in FIG. **5**;

FIG. **8** is a sectional view showing the example of the arrangement of the pixel of the light emitting device shown in FIG. **5**;

FIG. **9** is a view showing an example of the arrangement of a light emitting device according to the embodiment;

FIG. **10** is a circuit diagram showing an example of the arrangement of a pixel of the light emitting device shown in FIG. **9**;

FIG. **11** is a plan view showing the example of the arrangement of the pixel of the light emitting device shown in FIG. **9**;

FIG. **12** is a sectional view showing the example of the arrangement of the pixel of the light emitting device shown in FIG. **9**;

FIG. **13** is a view showing an example of a display device using the light emitting device according to the embodiment;

FIG. **14** is a view showing an example of a photoelectric conversion device using the light emitting device according to the embodiment;

FIG. **15** is a view showing an example of an electronic apparatus using the light emitting device according to the embodiment;

FIGS. **16**A and **16**B are views each showing an example of a display device using the light emitting device according to the embodiment;

FIG. **17** is a view showing an example of an illumination device using the light emitting device according to the embodiment;

FIG. **18** is a view showing an example of a moving body using the light emitting device according to the embodiment; and

FIGS. **19**A and **19**B are views each showing an example of a wearable device using the light emitting device according to the embodiment.

DESCRIPTION OF THE EMBODIMENTS

Hereinafter, embodiments will be described in detail with reference to the attached drawings. Note, the following embodiments are not intended to limit the scope of the claimed invention. Multiple features are described in the embodiments, but limitation is not made to an invention that requires all such features, and multiple such features may be combined as appropriate. Furthermore, in the attached drawings, the same reference numerals are given to the same or similar configurations, and redundant description thereof is omitted.

A light emitting device according to an embodiment of the present invention will be described with reference to FIGS. **1** to **12**. FIG. **1** is a schematic view showing an example of the arrangement of a light emitting device **101** according to this embodiment. FIG. **2** is a circuit diagram showing an example of the arrangement of a pixel **102** arranged in the light emitting device **101**.

A case will be described below in which a driving transistor **202** is connected to the anode of a light emitting element **201** arranged in each pixel **102** of the light emitting device **101** and all transistors arranged in the pixel **102** are p-type transistors. However, the arrangement of the pixel **102** of the light emitting device **101** is not limited to this. For example, the polarities or conductivity types of the respective transistors and the like may all be reversed. Alternatively, for example, the driving transistor may be a p-type transistor and the remaining transistors may be n-type transistors. Potentials to be supplied and connections are changed appropriately in accordance with the polarities or conductive types of the light emitting element and the transistors included in the pixel **102** of the light emitting device **101**.

In this embodiment, as shown in FIG. **1**, the light emitting device **101** includes a pixel array **103** and a driving circuit arranged on the periphery of the pixel array **103**. The pixel array **103** includes the plurality of pixels **102** arranged in an array. Each pixel **102** includes the light emitting element **201**. The light emitting element **201** includes, for example, an anode and a cathode, and includes an organic layer including a light emitting layer between the anode and the cathode. In addition to the light emitting layer, the organic layer may appropriately include one or more of a hole injection layer, a hole transport layer, an electron injection layer, and an electron transport layer. In other words, the light emitting element **201** may be an Organic Electroluminescent (EL) element.

The driving circuit is a circuit configured to drive the pixels **102** arranged in the pixel array **103**. The driving circuit includes, for example, a vertical scanning circuit **104** and a signal output circuit **105**. To supply a signal from the driving circuit to the pixel **102**, a scanning line **106** extending in a row direction (the horizontal direction in FIG. **1**) is arranged in the pixel array **103** for each pixel row of the pixels **102** arranged in an array. In addition, a signal line **107** extending in a column direction (the vertical direction in FIG. **1**) is arranged in the pixel array **103** for each pixel column of the pixels **102** arranged in an array.

Each scanning line **106** is connected to an output terminal of a corresponding pixel row of the vertical scanning circuit **104**. Each signal line **107** is connected to an output terminal of a corresponding pixel column of the signal output circuit **105**.

At the time of writing a video signal in each pixel **102** of the pixel array **103**, the vertical scanning circuit **104** supplies a write control signal to each scanning line **106**.

The signal output circuit **105** appropriately selects one of a reference voltage signal having a reference voltage and a luminance signal having a voltage corresponding to luminance information at the time of causing the light emitting element **201** of each pixel **102** to emit light, and outputs the selected signal to each signal line **107**. The luminance signal represents luminance at each pixel **102** of an image displayed by the light emitting device **101**, and can also be called a video signal.

The pixel **102** according to this embodiment shown in FIG. **2** includes the light emitting element **201**, the driving transistor **202** for supplying, to the light emitting element **201**, a current corresponding to the luminance signal, and a write transistor **203** for supplying the luminance signal to the gate electrode of the driving transistor. The total number of transistors and a combination of the conductivity types of the transistors are merely examples, and the present invention is not limited to them.

In this embodiment, one end of a current path including the light emitting element **201** and the driving transistor **202** is connected to a power supply potential Vss, and the other end is connected to a power supply potential Vdd. More specifically, the cathode of the light emitting element **201** is connected to the power supply potential Vss, and one (the source region in the arrangement shown in FIG. **2**) of diffusion regions respectively functioning as the source region and the drain region of the driving transistor **202** is connected to the power supply potential Vdd. However, the present invention is not limited to this, and another element may be arranged between the power supply potential Vss and the light emitting element **201** or between the power supply potential Vdd and the driving transistor **202**. Furthermore, another element may be arranged between the light emitting element **201** and the driving transistor **202**. In the arrangement shown in FIG. **2**, the power supply potential Vdd is higher than the power supply potential Vss.

The other (the drain region in the arrangement shown in FIG. **2**) of the diffusion regions respectively functioning as the source region and the drain region of the driving transistor **202** is connected to the anode of the light emitting element **201**. The gate electrode of the driving transistor **202** is connected to one (the drain region in the arrangement shown in FIG. **2**) of diffusion regions respectively functioning as the source region and the drain region of the write transistor **203**.

The write transistor **203** is arranged between the signal line **107** and the gate electrode of the driving transistor **202**. More specifically, one of the diffusion regions respectively functioning as the source region and the drain region of the write transistor **203** is connected to the gate electrode of the driving transistor **202**, as described above, and the other of the diffusion regions respectively functioning as the source region and the drain region of the write transistor **203** is connected to the signal line **107**. Furthermore, the gate electrode of the write transistor **203** is connected to the scanning line **106**.

The driving transistor **202** supplies a current from the power supply potential Vdd to the light emitting element **201**, thereby causing the light emitting element **201** to emit light. More specifically, the driving transistor **202** supplies a current corresponding to the signal voltage of the signal line **107** to the light emitting element **201**. Therefore, the driving transistor **202** current-drives the light emitting element **201** to emit light.

The write transistor **203** is set in the conductive state in response to a write control signal applied from the vertical scanning circuit **104** to the gate electrode via the scanning line **106**. Thus, the write transistor **203** samples the reference voltage or the signal voltage of the luminance signal corresponding to the luminance information supplied from the signal output circuit **105** via the signal line **107**, and writes it in the pixel **102**. The written signal voltage or reference voltage is applied to the gate electrode of the driving transistor **202**. That is, the write transistor **203** is arranged to transmit the luminance signal for causing the light emitting element **201** to emit light with luminance corresponding to the luminance information, and transmits the luminance signal to the gate electrode of the driving transistor **202**.

An organic EL element can be used as the light emitting element **201**. At the time of light emission of the light emitting element **201**, the amount of a current flowing through the driving transistor **202** changes in accordance with the signal voltage applied from the signal line **107** to the gate electrode of the driving transistor **202** via the write transistor **203**. This charges the capacitance between the anode and the cathode of the light emitting element **201** to a predetermined potential, and a current corresponding to the potential difference flows. Thus, the light emitting element **201** emits light with predetermined luminance.

The driving transistor **202** and the write transistor **203** included in the pixel **102** will be described in detail next with reference to FIGS. **3** and **4**. FIG. **3** is a plan view showing the outline of the pixel **102**, and FIG. **4** is a sectional view taken along a line Y1-Y1' shown in FIG. **3**.

The driving transistor **202** includes two p-type diffusion regions **302** and **303** respectively functioning as the source region and the drain region arranged in the current path including the light emitting element **201**. The driving transistor **202** includes a gate electrode **301**. As described above, the luminance signal is transmitted from the write transistor **203** to the gate electrode **301**.

In this embodiment, the conductivity type of the gate electrode **301** of the driving transistor **202** as a p-type transistor is an n type, which has a polarity opposite to those of the p-type diffusion regions **302** and **303**. By using the n-type gate electrode **301** with respect to the p-type diffusion regions **302** and **303**, it is possible to increase the threshold voltage of the difference in the work function, and suppress the off-leakage current of the driving transistor **202**. If the off-leakage current of the driving transistor **202** is suppressed, deeper black display can be implemented, thereby obtaining high contrast.

The write transistor **203** includes a gate electrode **304** and p-type diffusion regions **305** and **306** respectively functioning as the source region and the drain region. The diffusion region **306** is connected to the gate electrode **301** of the driving transistor **202**. The diffusion region **305** is connected to the signal line **107**, and the gate electrode **304** is connected to the scanning line **106**.

In this embodiment, the conductivity type of the gate electrode **304** of the write transistor **203** as a p-type transistor is an n type, which has a polarity opposite to those of the p-type diffusion regions **305** and **306**. By using the n-type gate electrode **304** with respect to the p-type diffusion regions **305** and **306**, it is possible to increase the threshold voltage of the difference in the work function, and suppress the off-leakage current of the write transistor **203**. If the off-leakage current of the write transistor **203** is suppressed, the signal voltage of the luminance signal written in the gate electrode **301** of the driving transistor **202** during a light emission period can be kept more constant. As a result, it is possible to suppress a luminance change of the light emitting element **201**, thereby implementing high-quality display.

In this embodiment, the driving transistor **202** and the write transistor **203** are arranged in an n-type well **403** provided on a p-type substrate **405**. A well contact **307** applies the power supply potential Vdd to the n-type well **403**. For an element isolation portion **404**, an appropriate structure such as shallow trench isolation (STI), local oxidation of silicon (LOCOS) isolation, or n-type diffusion layer isolation is used.

The present inventor has examined the light emitting device **101** having the above-described arrangement, and has found the following problem. In a process of forming the channel region of the write transistor **203**, the characteristic distribution of the threshold voltage and the channel density of the write transistor **203** is generated in accordance with the distribution of the injection amount of impurity ions. Thus, the off-leakage current of the write transistor **203** is not stabilized, and the signal voltage of the gate electrode **301** of the driving transistor **202** during the light emission period changes for each pixel **102** to change the amount of a current supplied to the light emitting element **201**, thereby causing display unevenness.

To solve this problem, the channel region **402** of the write transistor **203** may be a p-type or n-type diffusion layer, but it is effective to suppress the impurity concentration to be as low as possible. This suppresses the variations of the channel density, the threshold voltage, and the off-leakage current of the write transistor **203**, thereby suppressing the change of the signal voltage of the gate electrode **301** of the driving transistor **202** for each pixel **102** during the light emission period. Thus, the variation of the amount of the current supplied to the light emitting element **201** is suppressed. That is, as the impurity concentration of the channel region **402** of the write transistor **203** is closer to "0", the variation of the amount of the current supplied to the light emitting element can be suppressed more.

For example, the impurity concentration of a channel region **402** of the write transistor **203** may be lower than that of the well **403**. For example, the impurity concentration of the channel region **402** of the write transistor **203** may be substantially equal to that of a channel region **401** of the driving transistor **202**. Similarly, for example, the impurity concentration of the channel region **402** of the write transistor **203** may be substantially equal to that of a channel region of a transistor in the circuit of the driving circuit (for example, the vertical scanning circuit **104** and the signal output circuit **105**) arranged on the periphery of the pixel array **103**. This eliminates the need to increase the number of processes when forming each of the channel regions of the write transistor **203**, the driving transistor **202**, and the transistor in the circuit of the driving circuit arranged on the periphery of the pixel array **103**. In this specification, the impurity concentration can indicate the concentration based on the number of carriers decided based on the difference between the number of holes and the number of electrons in each region functioning as a p type or n type.

Furthermore, as shown in FIG. **4**, the channel region **402** of the write transistor **203** may be a p-type buried channel. By forming the channel region **402** as a p-type buried channel, it is possible to suppress a fluctuation of a current caused by Random Telegraph Signal (RTS) noise of the write transistor **203**. In this case as well, the impurity concentration of the channel region **402** of the write transistor **203** may be lower than that of the well **403**. For example, the impurity concentration of the channel region **402** of the write transistor **203** may be substantially equal to the impurity concentration of the channel region **401** of the driving transistor **202** and the impurity concentration of the channel region of the transistor in the circuit of the driving circuit arranged on the periphery of the pixel array **103**.

Similarly, as shown in FIG. **4**, the channel region **401** of the driving transistor **202** may be a p-type buried channel. By forming the channel region **401** as a p-type buried channel, it is possible to suppress a fluctuation of a current caused by RTS noise of the driving transistor **202**.

As described above, by using the n-type gate electrode **304** in the write transistor **203** which is a p-type transistor, the off-leakage current of the write transistor **203** is suppressed. Thus, the signal voltage of the luminance signal written in the gate electrode **301** of the driving transistor **202** during the light emission period can be kept more constant. As a result, it is possible to suppress a luminance change of the light emitting element **201**, thereby implementing high-quality display in the light emitting device **101**.

By setting the impurity concentration of the channel region **402** of the write transistor **203** low, the variations of the channel density, the threshold voltage, and the off-leakage current of the write transistor **203** are suppressed. Therefore, the change of the signal voltage of the gate electrode **301** of the driving transistor **202** for each pixel **102** during the light emission period can be suppressed, thereby suppressing display unevenness in the light emitting device **101**. As a result, it is possible to implement high-quality display in the light emitting device **101**.

A modification of the light emitting device **101** described above with reference to FIGS. **1** to **4** will be described next with reference to FIGS. **5** to **8**. FIG. **5** is a schematic view showing an example of the arrangement of a light emitting device **121** according to this embodiment. FIG. **6** is a circuit diagram showing an example of the arrangement of a pixel **122** arranged in the light emitting device **121**.

In this embodiment, as compared with the pixel **102** of the above-described light emitting device **101**, the pixel **122** of the light emitting device **121** further includes a light emission control transistor **221** arranged in a current path including the light emitting element **201** and the driving transistor **202** and configured to control light emission or non-light emission of the light emitting element **201**. In addition to the components of the pixel array **103** of the light emitting device **101**, a scanning line **123** for switching conduction/non-conduction of the light emission control transistor **221** is arranged in the pixel array **103** of the light emitting device **121**. The pixel **122** further includes capacitive elements **222** and **223**. The remaining components of the light emitting device **121** may be the same as those of the above-described light emitting device **101**. Components of the light emitting device **121** of this embodiment, which are different from the above-described light emitting device **101**, will mainly be described below.

As shown in FIG. **5**, the scanning line **123** extending in the row direction is arranged in the pixel array **103** for each pixel row of the pixels **122** arranged in an array. Each scanning line **123** is connected to an output terminal of a corresponding pixel row of the vertical scanning circuit **104**, and supplies a light emission control signal to each pixel **122**.

As shown in FIG. **6**, the light emission control transistor **221** is arranged between the driving transistor **202** and the power supply potential Vdd for supplying a driving current to the driving transistor **202**. More specifically, one (the source region in the arrangement shown in FIG. **6**) of diffusion regions respectively functioning as the source region and the drain region of the light emission control transistor **221** is connected to the power supply potential Vdd. The other (the drain region in the arrangement shown in FIG. **6**) of the diffusion regions respectively functioning as the source region and the drain region of the light emission control transistor **221** is connected to one (the source region in the arrangement shown in FIG. **6**) of the diffusion regions respectively functioning as the source region and the drain region of the driving transistor **202**. The gate electrode of the light emission control transistor **221** is connected to the scanning line **123**. However, the present invention is not limited to this, and for example, the light emission control transistor **221** may be arranged between the driving transistor **202** and the light emitting element **201**.

The capacitive element **222** is connected between the gate electrode of the driving transistor **202** and one (the source region in the arrangement shown in FIG. **6**) of the diffusion regions respectively functioning as the source region and the drain region of the driving transistor **202**. The capacitive element **223** is connected between the power supply potential Vdd and one (the source region in the arrangement shown in FIG. **6**) of the diffusion regions respectively functioning as the source region and the drain region of the driving transistor **202**. The capacitive elements **222** and **223** may be parasitic capacitances of the driving transistor **202** and the light emission control transistor **221**. Alternatively, the capacitive elements **222** and **223** may be elements each having the Metal-Insulator-Metal (MIM) structure.

In response to a light emission control signal applied from the vertical scanning circuit **104** to a control terminal via the scanning line **123**, the light emission control transistor **221** is set in the conductive state to permit supply of a current from the power supply potential Vdd to the driving transistor **202**. This allows the driving transistor **202** to drive the light emitting element **201**. That is, the light emission control transistor **221** functions as a switch element for controlling light emission/non-light emission of the light emitting element **201** by controlling the conductive state of the current path in which the light emitting element **201** is arranged.

The switching operation of the light emission control transistor **221** can provide a period (non-light emission period) during which the light emitting element **201** is in a non-light emission state, and control the ratio between the non-light emission period and a light emission period during which the light emitting element **201** emits light (so-called duty control). The duty control can reduce afterimage blurring accompanying light emission of the light emitting element **201** of each pixel **122** over a period of one frame, thereby making it possible to further improve especially image quality of a moving image. By arranging the two capacitive elements **222** and **223**, it is possible to keep the signal voltage of the gate electrode **301** of the driving transistor **202** more constant and suppress a luminance change, thereby implementing high-quality display. This embodiment does not inhibit the effect of suppression of the off-leakage current of the write transistor **203** and suppression of the variation of the write transistor **203**, and thus high-quality display is maintained.

The light emission control transistor **221** will be described in detail next with reference to FIGS. **7** and **8**. FIG. **7** is a plan view showing the outline of the pixel **122**, and FIG. **8** is a sectional view taken along a line Y2-Y2' shown in FIG. **7**.

As shown in FIGS. **7** and **8**, the light emission control transistor **221** includes an n-type gate electrode **321**, and the p-type diffusion region **302** and a p-type diffusion region **322** respectively functioning as the source region and the drain region arranged in the current path including the light emitting element **201**. In this embodiment, the diffusion region **302** is shared with the driving transistor **202**. However, the present invention is not limited to this, and the diffusion regions of the driving transistor **202** and the light emission control transistor **221** may be independent of each other. The gate electrode **304** is connected to the scanning line **123**, as described above.

In this embodiment, a length **323**, in a current flowing direction, of the diffusion region **306** of the write transistor **203** connected to the gate electrode **301** of the driving transistor **202** is longer than a length **324**, in a current flowing direction, of the diffusion region **302** shared by the driving transistor **202** and the light emission control transistor **221**. As shown in FIG. **7**, the length **323** in the current flowing direction of the diffusion region **306** may be defined as a length in the current flowing direction (the vertical direction in FIG. **7**) from the end portion, on the side of the diffusion region **306**, of the gate electrode **304** of the write transistor **203** to a portion where the polarities of the diffusion region **306** and the well **403** change, in orthogonal projection to a surface of the substrate **405** on which the write transistor **203** is arranged. Alternatively, the length **323** in the current flowing direction of the diffusion region **306** may be defined as a length in the current flowing direction from the end portion, on the side of the diffusion region **306**, of the gate electrode **304** of the write transistor **203** to a portion where the impurity concentration of the diffusion region **306** becomes ½, ⅕, or ⅒, in orthogonal projection to the surface of the substrate **405** on which the write transistor **203** is arranged. Furthermore, the length **324** in the current flowing direction of the diffusion region **302** may be defined as a length in the current flowing direction (the vertical direction in FIG. **7**) between the gate electrode **301** of the driving transistor **202** and the gate electrode **321** of the light emission control transistor **221**, in orthogonal projection to a surface of the substrate **405** on which the driving transistor **202** and the light emission control transistor **221** are arranged.

By setting the length **323** longer than the length **324**, the parasitic capacitance of the p-type diffusion region **306** increases, and thus the signal voltage written in the gate electrode **301** of the driving transistor **202** connected to the diffusion region **306** can be kept more constant. As a result, it is possible to suppress a luminance change, thereby implementing high-quality display.

As shown in FIG. **8**, the impurity concentration of a channel region **421** of the light emission control transistor **221** may be substantially equal to that of the channel region **402** of the write transistor **203**, that of the channel region **401** of the driving transistor **202**, and that of the channel region of the transistor in the circuit of the driving circuit (for example, the vertical scanning circuit **104** and the signal output circuit **105**) arranged on the periphery of the pixel array **103**. That is, the impurity concentration of the light emission control transistor **221** may be lower than that of the well **403**, together with the impurity concentration of the channel region **402** of the write transistor **203** and the impurity concentration of the channel region **401** of the driving transistor **202**. As shown in FIG. **8**, the channel region **401** of the driving transistor **202** may be a p-type buried channel, similar to the channel region **402** of the write transistor **203** and the channel region **401** of the driving transistor **202**. This eliminates the need to increase the number of processes when forming each of the channel regions of the light emission control transistor **221**, the write transistor **203**, the driving transistor **202**, and the transistor in the circuit of the driving circuit of the pixel array **103**. If the light emission control transistor **221** has the same arrangement as that of the write transistor **203**, it is possible to suppress a fluctuation of a current caused by RTS noise and the off-leakage current of the light emission control transistor **221**.

A modification of the above-described light emitting device **101** or **121** will be described next with reference to FIGS. **9** to **12**. FIG. **9** is a schematic view showing an example of the arrangement of a light emitting device **141** according to this embodiment. FIG. **10** is a circuit diagram showing an example of the arrangement of a pixel **142** arranged in the light emitting device **141**.

In this embodiment, as compared with the pixel **122** of the above-described light emitting device **121**, the pixel **142** of the light emitting device **141** further includes a reset transistor **241** that short-circuits the two terminals of the light emitting element **201**, in other words, that connects the anode of the light emitting element **201** to the power supply potential Vss. In addition to the components of the pixel array **103** of the light emitting device **121**, a scanning line **143** for switching conduction/non-conduction of the reset transistor **241** is arranged in the pixel array **103** of the light emitting device **141**. The remaining components may be the same as those of the above-described light emitting device **121**. Components of the light emitting device **141** of this embodiment, which are different from the above-described light emitting device **121**, will mainly be described below.

As shown in FIG. **9**, the scanning line **143** extending in the row direction is arranged in the pixel array **103** for each pixel row of the pixels **142** arranged in an array. Each scanning line **143** is connected to an output terminal of a corresponding pixel row of the vertical scanning circuit **104**, and supplies a reset signal to each pixel **142**.

As shown in FIG. **10**, one (the source region in the arrangement shown in FIG. **10**) of diffusion regions respectively functioning as the source region and the drain region of the reset transistor **241** is connected to the anode of the light emitting element **201** and the other (the drain region in the arrangement shown in FIG. **10**) of the diffusion regions respectively functioning as the source region and the drain region of the driving transistor **202**. The other (the drain region in the arrangement shown in FIG. **10**) of the diffusion regions respectively functioning as the source region and the drain region of the reset transistor **241** is connected to the power supply potential Vss. The gate electrode of the reset transistor **241** is connected to the scanning line **143**.

During the non-light emission period of the pixel **142**, if the reset transistor **241** is set in the conductive state, the anode of the light emitting element **201** is connected to the power supply potential Vss and the two terminals of the light emitting element **201** are short-circuited. This can set the light emitting element **201** in the non-light emission state (reset operation). By providing the reset transistor **241** in the pixel **142**, the light emitting element **201** is caused to surely perform black display during the non-light emission period, thereby implementing the light emitting device **141** with a high contrast ratio. Note that this embodiment does not inhibit the effect of suppression of the off-leakage current of the write transistor **203** and suppression of the variation of the write transistor **203**, and thus high-quality display is maintained.

The reset transistor **241** will be described in detail next with reference to FIGS. **11** and **12**. FIG. **11** is a plan view showing the outline of the pixel **142**, and FIG. **12** is a sectional view taken along a line Y3-Y3' shown in FIG. **11**.

As shown in FIGS. **11** and **12**, the reset transistor **241** includes a p-type gate electrode **341**, and the p-type diffusion region **303** and a diffusion region **342** respectively functioning as the source region and the drain region. In this embodiment, the diffusion region **303** is shared with the driving transistor **202**. However, the present invention is not limited to this, and the diffusion regions of the driving transistor **202** and the reset transistor **241** may be independent of each other. The gate electrode **304** is connected to the scanning line **143**, as described above.

As shown in FIG. **12**, the impurity concentration of a channel region **441** of the reset transistor **241** may be substantially equal to that of the channel region **402** of the write transistor **203**, that of the channel region **401** of the driving transistor **202**, that of the channel region **421** of the light emission control transistor **221**, and that of the channel region of the transistor in the circuit of the driving circuit (for example, the vertical scanning circuit **104** and the signal output circuit **105**) arranged on the periphery of the pixel array **103**. That is, the impurity concentration of the reset transistor **241** may be lower than that of the well **403**, together with the impurity concentration of the channel region **402** of the write transistor **203**, the impurity concentration of the channel region **401** of the driving transistor **202**, and the impurity concentration of the channel region **421** of the light emission control transistor **221**. As shown in FIG. **12**, the channel region **401** of the driving transistor **202** may be a p-type buried channel, similar to the channel region **402** of the write transistor **203** and the channel region

401 of the driving transistor 202. This eliminates the need to increase the number of processes when forming each of the channel regions of the reset transistor 241, the write transistor 203, the driving transistor 202, the light emission control transistor 221, and the transistor in the circuit of the driving circuit arranged on the periphery of the pixel array 103. If the reset transistor 241 has the same arrangement as that of the write transistor 203, it is possible to suppress a fluctuation of a current caused by RTS noise and the off-leakage current of the reset transistor 241.

As shown in FIG. 12, the conductivity type of the gate electrode 341 of the reset transistor 241 may be a p type different from the conductivity type of the gate electrode 304 of the write transistor 203. This can decrease the threshold voltage of the reset transistor 241, and suppress the potential of the anode of the light emitting element 201 from becoming higher than the power supply potential Vss at the time of the reset operation. If the pixel 142 includes the reset transistor 241, it is possible to cause the light emitting element 201 to transition to the non-light emission state more reliably, and the light emitting device 141 can implement high-quality display with higher contrast.

The organic EL element has been exemplified as the light emitting element 201 but the light emitting element 201 is not limited to this. The light emitting element 201 can be applied to the general light emitting device using a current-driven electro-optical element (light emitting element) whose light emission luminance changes in accordance with the value of a current flowing through the element, such as an inorganic EL element, an LED element, or a semiconductor laser element.

Application examples in which the light emitting device 101, 121, or 141 according to this embodiment is applied to a display device, a photoelectric conversion device, an electronic apparatus, an illumination device, a moving body, and a wearable device will be described here with reference to FIGS. 13 to 19A and 19B.

FIG. 13 is a schematic view showing an example of the display device using the light emitting device 101, 121, or 141 of this embodiment. A display device 1000 can include a touch panel 1003, a display panel 1005, a frame 1006, a circuit board 1007, and a battery 1008 between an upper cover 1001 and a lower cover 1009. Flexible printed circuits (FPCs) 1002 and 1004 are respectively connected to the touch panel 1003 and the display panel 1005. Active elements such as transistors are arranged on the circuit board 1007. The battery 1008 is unnecessary if the display device 1000 is not a portable apparatus. Even when the display device 1000 is a portable apparatus, the battery 1008 need not be provided at this position. The light emitting device 101, 121, or 141 according to this embodiment can be applied to the display panel 1005. The pixel array 103 of the light emitting device 101, 121, or 141 functioning as the display panel 1005 is connected to the active elements such as transistors arranged on the circuit board 1007 and operates.

The display device 1000 shown in FIG. 13 can be used for a display unit of a photoelectric conversion device (image capturing device) including an optical unit having a plurality of lenses, and an image sensor for receiving light having passed through the optical unit and photoelectrically converting the light into an electric signal. The photoelectric conversion device can include a display unit for displaying information acquired by the image sensor. In addition, the display unit can be either a display unit exposed outside the photoelectric conversion device, or a display unit arranged in the finder. The photoelectric conversion device can be a digital camera or a digital video camera.

FIG. 14 is a schematic view showing an example of the photoelectric conversion device using the light emitting device 101, 121, or 141 of this embodiment. A photoelectric conversion device 1100 can include a viewfinder 1101, a rear display 1102, an operation unit 1103, and a housing 1104. The photoelectric conversion device 1100 can also be called an image capturing device. The light emitting device 101, 121, or 141 according to this embodiment can be applied to the viewfinder 1101 or the rear display 1102 as a display unit. In this case, the light emitting device 101, 121, or 141 can display not only an image to be captured but also environment information, image capturing instructions, and the like. Examples of the environment information are the intensity and direction of external light, the moving velocity of an object, and the possibility that an object is covered with an obstacle.

The timing suitable for image capturing is a very short time in many cases, so the information should be displayed as soon as possible. Therefore, the light emitting device 101, 121, or 141 containing the organic light emitting material such as an organic EL element in the light emitting layer may be used for the viewfinder 1101 or the rear display 1102. This is so because the organic light emitting material has a high response speed. The light emitting device 101, 121, or 141 using the organic light emitting material can be used for the apparatuses that require a high display speed more suitably than for the liquid crystal display device.

The photoelectric conversion device 1100 includes an optical unit (not shown). This optical unit has a plurality of lenses, and forms an image on a photoelectric conversion element (not shown) that receives light having passed through the optical unit and is accommodated in the housing 1104. The focal points of the plurality of lenses can be adjusted by adjusting the relative positions. This operation can also automatically be performed.

The light emitting device 101, 121, or 141 may be applied to a display unit of an electronic apparatus. At this time, the display unit can have both a display function and an operation function. Examples of the portable terminal are a portable phone such as a smartphone, a tablet, and a head mounted display.

FIG. 15 is a schematic view showing an example of an electronic apparatus using the light emitting device 101, 121, or 141 of this embodiment. An electronic apparatus 1200 includes a display unit 1201, an operation unit 1202, and a housing 1203. The housing 1203 can accommodate a circuit, a printed board having this circuit, a battery, and a communication unit. The operation unit 1202 can be a button or a touch-panel-type reaction unit. The operation unit 1202 can also be a biometric authentication unit that performs unlocking or the like by authenticating the fingerprint. The portable apparatus including the communication unit can also be regarded as a communication apparatus. The light emitting device 101 according to this embodiment can be applied to the display unit 1201.

FIGS. 16A and 16B are schematic views showing examples of the display device using the light emitting device 101, 121, or 141 of this embodiment. FIG. 16A shows a display device such as a television monitor or a PC monitor. A display device 1300 includes a frame 1301 and a display unit 1302. The light emitting device 101, 121, or 141 according to this embodiment can be applied to the display unit 1302. The display device 1300 can include a base 1303 that supports the frame 1301 and the display unit 1302. The base 1303 is not limited to the form shown in FIG.

16A. For example, the lower side of the frame **1301** may also function as the base **1303**. In addition, the frame **1301** and the display unit **1302** can be bent. The radius of curvature in this case can be 5,000 mm (inclusive) to 6,000 mm (inclusive).

FIG. **16**B is a schematic view showing another example of the display device using the light emitting device **101**, **121**, or **141** of this embodiment. A display device **1310** shown in FIG. **16**B can be folded, and is a so-called foldable display device. The display device **1310** includes a first display unit **1311**, a second display unit **1312**, a housing **1313**, and a bending point **1314**. The light emitting device **101**, **121**, or **141** according to this embodiment can be applied to each of the first display unit **1311** and the second display unit **1312**. The first display unit **1311** and the second display unit **1312** can also be one seamless display device. The first display unit **1311** and the second display unit **1312** can be divided by the bending point. The first display unit **1311** and the second display unit **1312** can display different images, and can also display one image together.

FIG. **17** is a schematic view showing an example of the illumination device using the light emitting device **101**, **121**, or **141** of this embodiment. An illumination device **1400** can include a housing **1401**, a light source **1402**, a circuit board **1403**, an optical film **1404**, and a light diffusing unit **1405**. The light emitting device **101**, **121**, or **141** according to this embodiment can be applied to the light source **1402**. The optical film **1404** can be a filter that improves the color rendering of the light source. When performing lighting-up or the like, the light diffusing unit **1405** can throw the light of the light source over a broad range by effectively diffusing the light. The illumination device can also include a cover on the outermost portion, as needed. The illumination device **1400** can include both or one of the optical film **1404** and the light diffusing unit **1405**.

The illumination device **1400** is, for example, a device for illuminating the interior of the room. The illumination device **1400** can emit white light, natural white light, or light of any color from blue to red. The illumination device **1400** can also include a light control circuit for controlling these light components. The illumination device **1400** can also include a power supply circuit connected to the light emitting device **101**, **121**, or **141** functioning as the light source **1402**. The power supply circuit is a circuit for converting an AC voltage into a DC voltage. White has a color temperature of 4,200 K, and natural white has a color temperature of 5,000 K. The illumination device **1400** may also include a color filter. In addition, the illumination device **1400** can include a heat radiation unit. The heat radiation unit radiates the internal heat of the device to the outside of the device, and examples are a metal having a high specific heat and liquid silicon.

FIG. **18** is a schematic view of an automobile having a taillight as an example of a vehicle lighting appliance using the light emitting device **101**, **121**, or **141** of this embodiment. An automobile **1500** has a taillight **1501**, and can have a form in which the taillight **1501** is turned on when performing a braking operation or the like. The light emitting device **101**, **121**, or **141** of this embodiment can be used as a headlight serving as a vehicle lighting appliance. The automobile is an example of a moving body, and the moving body may be a ship, a drone, an aircraft, a railroad car, an industrial robot, or the like. The moving body may include a main body and a lighting appliance provided in the main body. The lighting appliance may be used to make a notification of the current position of the main body.

The light emitting device **101**, **121**, or **141** according to this embodiment can be applied to the taillight **1501**. The taillight **1501** can include a protection member for protecting the light emitting device **101**, **121**, or **141** functioning as the taillight **1501**. The material of the protection member is not limited as long as the material is a transparent material with a strength that is high to some extent, and an example is polycarbonate. The protection member may be made of a material obtained by mixing a furandicarboxylic acid derivative, an acrylonitrile derivative, or the like in polycarbonate.

The automobile **1500** can include a vehicle body **1503**, and a window **1502** attached to the vehicle body **1503**. This window can be a window for checking the front and back of the automobile, and can also be a transparent display. For this transparent display, the light emitting device **101**, **121**, or **141** according to this embodiment may be used. In this case, the constituent materials of the electrodes and the like of the light emitting device **101**, **121**, or **141** are formed by transparent members.

Further application examples of the light emitting device **101**, **121**, or **141** according to this embodiment will be described with reference to FIGS. **19**A and **19**B. The light emitting device **101**, **121**, or **141** can be applied to a system that can be worn as a wearable device such as smartglasses, a Head Mounted Display (HMD), or a smart contact lens. An image capturing display device used for such application examples includes an image capturing device capable of photoelectrically converting visible light and a light emitting device capable of emitting visible light.

Glasses **1600** (smartglasses) according to one application example will be described with reference to FIG. **19**A. An image capturing device **1602** such as a CMOS sensor or an SPAD is provided on the surface side of a lens **1601** of the glasses **1600**. In addition, the light emitting device **101**, **121**, or **141** according to this embodiment is provided on the back surface side of the lens **1601**.

The glasses **1600** further include a control device **1603**. The control device **1603** functions as a power supply that supplies electric power to the image capturing device **1602** and the light emitting device **101**, **121**, or **141** according to each embodiment. In addition, the control device **1603** controls the operations of the image capturing device **1602** and the light emitting device **101**, **121**, or **141**. An optical system configured to condense light to the image capturing device **1602** is formed on the lens **1601**.

Glasses **1610** (smartglasses) according to one application example will be described with reference to FIG. **19**B. The glasses **1610** include a control device **1612**, and an image capturing device corresponding to the image capturing device **1602** and the light emitting device **101**, **121**, or **141** are mounted on the control device **1612**. The image capturing device in the control device **1612** and an optical system configured to project light emitted from the light emitting device **101**, **121**, or **141** are formed in a lens **1611**, and an image is projected to the lens **1611**. The control device **1612** functions as a power supply that supplies electric power to the image capturing device and the light emitting device **101**, **121**, or **141**, and controls the operations of the image capturing device and the light emitting device **101**, **121**, or **141**. The control device **1612** may include a line-of-sight detection unit that detects the line of sight of a wearer. The detection of a line of sight may be done using infrared rays. An infrared ray emitting unit emits infrared rays to an eyeball of the user who is gazing at a displayed image. An image capturing unit including a light receiving element detects reflected light of the emitted infrared rays from the eyeball, thereby obtaining a captured image of the eyeball.

A reduction unit for reducing light from the infrared ray emitting unit to the display unit in a planar view is provided, thereby reducing deterioration of image quality.

The line of sight of the user to the displayed image is detected from the captured image of the eyeball obtained by capturing the infrared rays. An arbitrary known method can be applied to the line-of-sight detection using the captured image of the eyeball. As an example, a line-of-sight detection method based on a Purkinje image obtained by reflection of irradiation light by a cornea can be used.

More specifically, line-of-sight detection processing based on pupil center corneal reflection is performed. Using pupil center corneal reflection, a line-of-sight vector representing the direction (rotation angle) of the eyeball is calculated based on the image of the pupil and the Purkinje image included in the captured image of the eyeball, thereby detecting the line-of-sight of the user.

The light emitting device **101**, **121**, or **141** according to the embodiment of the present invention can include an image capturing device including a light receiving element, and control a displayed image based on the line-of-sight information of the user from the image capturing device.

More specifically, the light emitting device **101**, **121**, or **141** decides a first visual field region at which the user is gazing and a second visual field region other than the first visual field region based on the line-of-sight information. The first visual field region and the second visual field region may be decided by the control device of the light emitting device **101**, **121**, or **141**, or those decided by an external control device may be received. In the display region of the light emitting device **101**, **121**, or **141**, the display resolution of the first visual field region may be controlled to be higher than the display resolution of the second visual field region. That is, the resolution of the second visual field region may be lower than that of the first visual field region.

In addition, the display region includes a first display region and a second display region different from the first display region, and a region of higher priority is decided from the first display region and the second display region based on line-of-sight information. The first display region and the second display region may be decided by the control device of the light emitting device **101**, **121**, or **141**, or those decided by an external control device may be received. The resolution of the region of higher priority may be controlled to be higher than the resolution of the region other than the region of higher priority. That is, the resolution of the region of relatively low priority may be low.

Note that AI may be used to decide the first visual field region or the region of higher priority. The AI may be a model configured to estimate the angle of the line of sight and the distance to a target ahead the line of sight from the image of the eyeball using the image of the eyeball and the direction of actual viewing of the eyeball in the image as supervised data. The AI program may be held by the light emitting device **101**, **121**, or **141**, the image capturing device, or an external device. If the external device holds the AI program, it is transmitted to the light emitting device **101**, **121**, or **141** via communication.

When performing display control based on line-of-sight detection, smartglasses further including an image capturing device configured to capture the outside can be applied. The smartglasses can display captured outside information in real time.

While the present invention has been described with reference to exemplary embodiments, it is to be understood that the invention is not limited to the disclosed exemplary embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

This application claims the benefit of Japanese Patent Application No. 2022-070269, filed Apr. 21, 2022, which is hereby incorporated by reference herein in its entirety.

What is claimed is:

1. A light emitting device in which a pixel is arranged, the pixel comprising (1) a light emitting element, (2) a first transistor configured to supply, to the light emitting element, a current corresponding to a luminance signal, and (3) a second transistor configured to supply the luminance signal to a gate electrode of the first transistor,

wherein diffusion regions respectively functioning as a source region and a drain region of the second transistor are of a first conductivity type,

wherein a gate electrode of the second transistor is of a second conductivity type opposite to the first conductivity type,

wherein the first transistor and the second transistor are arranged in a well of the second conductivity type, and

wherein an impurity concentration of a channel region of the second transistor is lower than an impurity concentration of the well.

2. The device according to claim **1**, wherein an impurity concentration of a channel region of the first transistor is equal to the impurity concentration of the channel region of the second transistor.

3. The device according to claim **2**, wherein the channel region of the first transistor and the channel region of the second transistor are of the first conductivity type.

4. The device according to claim **3**, wherein diffusion regions respectively functioning as a source region and a drain region of the first transistor are of the first conductivity type, and

wherein the gate electrode of the first transistor is of the second conductivity type.

5. The device according to claim **1**, wherein the channel region of the second transistor is of the first conductivity type.

6. The device according to claim **5**, wherein the light emitting device comprises (1) a pixel array in which a plurality of pixels including the pixel are arranged, and (2) a peripheral region in which a driving circuit configured to operate the plurality of pixels is arranged,

wherein a third transistor having a channel region of the first conductivity type is arranged in the peripheral region, and

wherein the impurity concentration of the channel region of the second transistor is equal to an impurity concentration of the channel region of the third transistor.

7. The device according to claim **1**, wherein the pixel further comprises another transistor, the another transistor being arranged in a current path including the light emitting element and the first transistor, and being configured to control light emission or non-light emission of the light emitting element.

8. The device according to claim **7**, wherein one of a source region and a drain region of the first transistor and another of a source region and a drain region of the another transistor share one diffusion region, and

wherein a length, in a current flowing direction, of the diffusion region of the second transistor connected to the gate electrode of the first transistor is longer than a length, in a current flowing direction, of the diffusion region shared by the first transistor and the another transistor.

9. The device according to claim 7, wherein the impurity concentration of the channel region of the second transistor is equal to an impurity concentration of a channel region of the another transistor.

10. The device according to claim 9, wherein the channel region of the second transistor and the channel region of the another transistor are of the first conductivity type.

11. The device according to claim 10, wherein diffusion regions respectively functioning as a source region and a drain region of the another transistor are of the first conductivity type, and

wherein a gate electrode of the another transistor is of the second conductivity type.

12. The device according to claim 1, wherein the pixel further comprises another transistor, the another transistor being configured to short-circuit two terminals of the light emitting element, and

wherein the impurity concentration of the channel region of the second transistor is equal to an impurity concentration of a channel region of the another transistor.

13. The device according to claim 12, wherein the channel region of the second transistor and the channel region of the another transistor are of the first conductivity type.

14. The device according to claim 13, wherein diffusion regions respectively functioning as a source region and a drain region of the another transistor are of the first conductivity type, and

wherein a gate electrode of the another transistor is of the first conductivity type.

15. A display device comprising the light emitting device according to claim 1, and an active element connected to the light emitting device.

16. A photoelectric conversion device comprising an optical unit including a plurality of lenses, an image sensor configured to receive light having passed through the optical unit, and a display unit configured to display an image,

wherein the display unit displays an image captured by the image sensor, and includes the light emitting device according to claim 1.

17. An electronic apparatus comprising a housing provided with a display unit, and a communication unit provided in the housing and configured to perform external communication,

wherein the display unit includes the light emitting device according to claim 1.

18. An illumination device comprising a light source, and at least one of a light diffusing unit and an optical film,

wherein the light source includes the light emitting device according to claim 1.

19. A moving body comprising a main body, and a lighting appliance provided in the main body,

wherein the lighting appliance includes the light emitting device according to claim 1.

20. A light emitting device in which a pixel is arranged, the pixel comprising (1) a light emitting element, (2) a first transistor configured to supply, to the light emitting element, a current corresponding to a luminance signal, (3) a second transistor configured to supply the luminance signal to a gate electrode of the first transistor, and (4) a third transistor configured to short-circuit two terminals of the light emitting element,

wherein diffusion regions respectively functioning as a source region and a drain region of the second transistor are of a first conductivity type,

wherein a gate electrode of the second transistor is of a second conductivity type opposite to the first conductivity type,

wherein diffusion regions respectively functioning as a source region and a drain region of the third transistor are of the first conductivity type, and

wherein a gate electrode of the third transistor is of the first conductivity type.

21. The device according to claim 20, wherein diffusion regions respectively functioning as a source region and a drain region of the first transistor are of the first conductivity type, and

wherein the gate electrode of the first transistor is of the second conductivity type.

22. The device according to claim 20, wherein the light emitting device comprises a pixel array in which a plurality of pixels including the pixel are arranged, and a peripheral region in which a driving circuit configured to operate the plurality of pixels is arranged,

wherein a fourth transistor having a channel region of the first conductivity type is arranged in the peripheral region, and

wherein the impurity concentration of the channel region of the second transistor is equal to an impurity concentration of the channel region of the fourth transistor.

23. The device according to claim 20, wherein the pixel further comprises another transistor, the another transistor being arranged in a current path including the light emitting element and the first transistor, and being configured to control light emission or non-light emission of the light emitting element.

24. The device according to claim 23, wherein one of a source region and a drain region of the first transistor and another of a source region and a drain region of the another transistor share one diffusion region, and

wherein a length, in a current flowing direction, of the diffusion region of the second transistor connected to the gate electrode of the first transistor is longer than a length, in a current flowing direction, of the diffusion region shared by the first transistor and the another transistor.

25. The device according to claim 23, wherein the impurity concentration of the channel region of the second transistor is equal to an impurity concentration of a channel region of the another transistor.

26. The device according to claim 25, wherein the channel region of the second transistor and the channel region of the another transistor are of the first conductivity type.

27. The device according to claim 26, wherein diffusion regions respectively functioning as a source region and a drain region of the another transistor are of the first conductivity type, and

wherein a gate electrode of the another transistor is of the second conductivity type.

28. The device according to claim 20, wherein the impurity concentration of the channel region of the second transistor is equal to an impurity concentration of a channel region of the third transistor.

29. The device according to claim 28, wherein the channel region of the second transistor and the channel region of the third transistor are of the first conductivity type.

30. A display device comprising the light emitting device according to claim 20, and an active element connected to the light emitting device.

31. An electronic apparatus comprising a housing provided with a display unit, and a communication unit provided in the housing and configured to perform external communication,

wherein the display unit includes the light emitting device according to claim **20**.

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